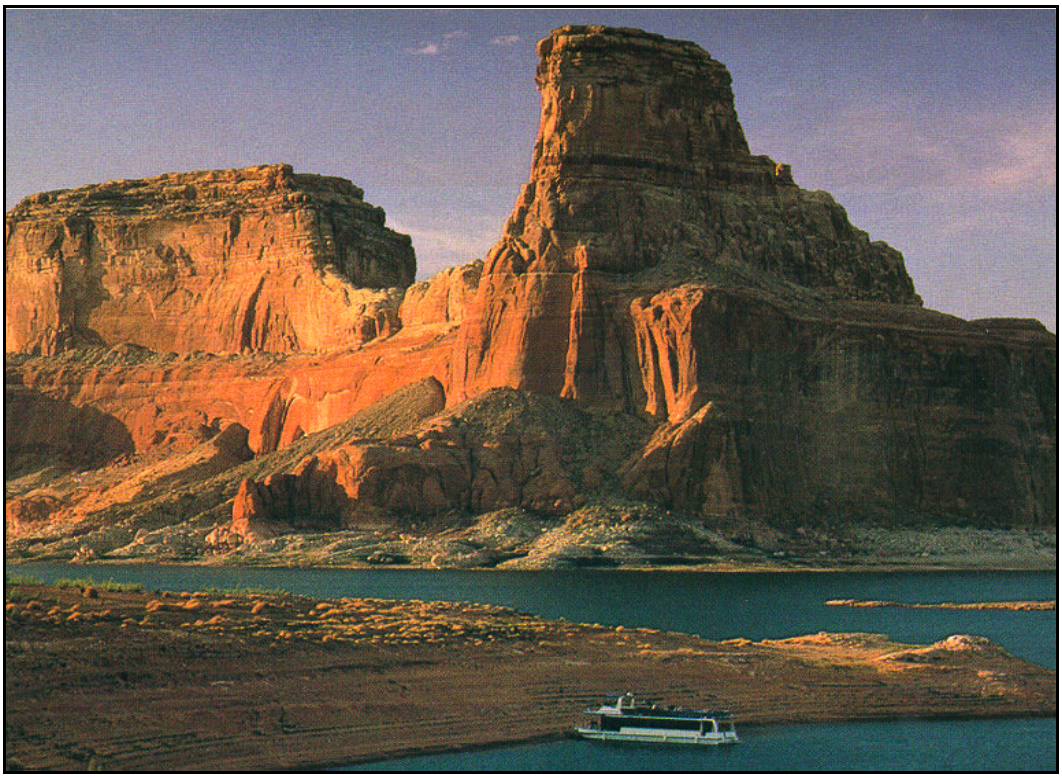
LAKE POWELL



Introduction

Lake Powell is the largest reservoir in Utah. It stretches from two miles south of the state line in Arizona upstream approximately 186 miles to Canyonlands National Park in Utah. It is known as an aquatic playground in the desert. It is named after John Wesley Powell, who led the first exploration of the Colorado River. Not long after Powell's voyage, permanent settlements were established at the easiest and most reliable river crossings. An early proponent of the need for reclamation activities in this arid country, Powell eventually was honored by having the lake named for him. The dam was born amid great controversy and compromise., It fulfills its goals of water storage and power generation and also provides major recreational opportunities. The resulting lake makes it possible for many people to view natural marvels and cultural features that once were accessible to only a determined few. Construction of the concrete arch dam began in 1956, and the final two generating units began

Characteristics and Morphometry

Lake elevation (meters / feet)	1,127 / 3,700
Surface area (hectares / acres)	65,843 / 162,700
Watershed area (hectares / acres)	26,700,000 / 65,800,000
Volume (m^3 / acre-feet)	
capacity	2.6526×10^{10} / 2.1505×10^{7}
conservation pool	none specified
Annual inflow (m^3 / acre-feet)	3.7×10^{9} / 3.0×10^{6}
Retention time (years)	7.2
Drawdown (m^3 / acre-feet)	3.7×10^{9} / 3.0×10^{6}
Vertical fluctuation (meters / feet)	6 / 18
Depth (meters / feet)	
maximum	170 / 560
mean	40 / 132
Length (kilometers / miles)	299 / 186
Width (kilometers / miles)	40 / 25
Shoreline (kilometers / miles)	3,057 / 1,900

Location

County	San Juan, Garfield, Kane
Longitude / Latitude	111 00 00 / 37 15 00
USGS Map	
DeLorme's Utah Atlas & Gazetteer™	Pages 20, 21, 29
Cataloging Unit	Upper Colorado

providing power in 1966.

The concrete arch dam and powerplant together required 5.1 million cubic yards of concrete-poured round the clock for more than three years. The dam's crest is 1,560 feet long. It lies 710 feet above bedrock and 583 feet above the original river channel. At its full pool elevation of 3,700 feet Lake Powell holds 27 million acre-feet of water, 560 feet deep at the dam.

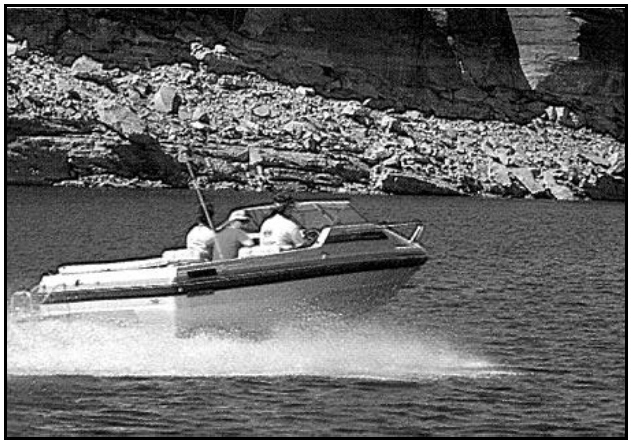
The lake reached full pool level in 1980. The spillways were used in that year and again in 1983 to handle the rising lake level caused by flood waters. In 1983, there was concern the dam might fail, when water ripped huge chunks of sandstone from the spillways. After lake elevations receded the spillways were repaired and management plans changed to fill the lake more slowly in the spring. Lake level dropped continually throughout the remainder of the 80's and early 90's, and at the present (June 1993), it is filling again.

It is an impoundment of Glen Canyon, and the sculpted Navajo Sandstone walls create almost 2,000 miles of shoreline. The Glen Canyon National Recreation Area encloses most of the reservoir, with the Navaho Indian Reservation on the south shore from the dam eastward on the San Juan River arm. Public access is unrestricted in the NRA, but there is no public access on the reservation. Reservoir water is not used in Utah, but in Arizona, Nevada, California, and Mexico. Water is used for agriculture, culinary, recreation, aquatic life, recreation, and hydropower. Water use is not expected to change in the foreseeable future.

Recreation

Lake Powell is accessible from U-95 near Hite, U-276 at Hall's Crossing and Bullfrog Bay, and US-89 just north of the Arizona Border.

Water sports dominate recreation activities at Glen Canyon National Recreation Area. Concessioners offer boat tours that last from an hour to all day and provide boat rentals at developed areas. Houseboats provide comfort at a relaxed pace, as well as a chance to sightsee beyond developed areas. Sailing is best at Wahweap, Padre, and Bullfrog Bays. Canoes and kayaks provide access to secluded areas in small canyons. Lake waters are relatively warm from June through September making swimming, snorkeling, SCUBA diving and water skiing enjoyable.



Fishing is rewarding all year. Primary game species are largemouth (*Micropterus salmoides*) and striped bass (*Morone saxatilis*), black crappie (*Pomoxis nigromaculatus*), catfish (*Ictalurus punctatus*), bluegill (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*), and walleye (*Stizostedion vitreum*). The cold waters of the Colorado River below the dam provide excellent trophy trout habitat. Fishermen frequently catch very large rainbow trout upstream from Lees Ferry.

There is excellent camping on flat sites along the lakeshore. You can supplement your water sports with a hike in desert side canyons on trails of your own choosing Please exercise reasonable caution. Backcountry hiking in the canyon country requires planning and stamina. However, the rewards can far outweigh the efforts of preparation and the exertion of the experience itself.

Mountain biking is becoming a popular activity within the recreation area. Routes in the park provide various levels of difficulty and maps are available. For more information about facilities, activities, and regulations write to the Superintendent, Glen Canyon National Recreation Area, P.O. Box 1507, Page, AZ 86040.

Watershed Description

Lake Powell is an impoundment of the Colorado River at the Utah/Arizona state line. It drains the deserts of eastern Utah with plateaus to the west, the Uinta Mountains, the high plains of southwestern Wyoming where the Green River has its source. All of western Colorado, northwestern New Mexico, and northeastern Arizona drain into Lake Powell.

The area around the reservoir is mostly Navaho Sandstone, the same strata that the canyons of Zions National Park are carved in, as well as the Slickrock Trail in Moab. The spectacular landscape dominating this canyon country is the product of eons of geologic activity: shifting of continents, global rising and falling of sea levels, and creation of highlands now worn and redeposited. At times, desert dominated the landscape; sometimes, freshwater or saltwater seas invaded, leaving rivers to erode the most recently deposited layers. The process was assisted by prevailing winds. These periods of erosion account for missing rock strata–layers that appear elsewhere in sequence. The last uplift of the Colorado Plateau began about 60 million years ago. Uplift made meandering streams of the Colorado River run faster and cut the canyons that are Lake Powell's basin. Navajo sandstone, the dominant formation, is made of sand dunes hardened by pressure from deposits above them. The deposits eventually wore away and exposed today's sandstone. Other layers contain sea-deposited sediments; still others hold fossils of land or marine organisms that lived millions of years ago. Petrified wood and fossils of dinosaur bones, sea shell, and small sea creatures are found in several rock strata in this area.

Most plants and animals found here are typical of desert species. Cactus, yucca, blackbrush, rabbitbrush, and grasses dominate desert plant communities. Spring or summer precipitation prompts sand lilies, fleabane, evening primrose, lupine, Indian paintbrush, and globe mallow to bloom. Pinyon and juniper trees grow at higher elevations. Common animal inhabitants include coyotes, foxes, rats, mice, lizards, and insects. In startling contrast, shady springfed alcoves in side canyons provide suitable habitat for deer and beaver, ferns and sedges, reeds and cattails, cottonwoods and willows. Ravens, eagles, hawks, owls, sparrows, and swallows are regular residents of the canyon country, where canyon wrens sing their unforgettable song.

The watershed high point is 4,400 m (14,433 ft) above sea level, thereby developing a complex slope of 0.6% to the reservoir. The average stream gradient of the Colorado River is 0.7% (36 feet per mile) Major inflows include the Escalante River, the Dirty Devil River, the Colorado River and the San Juan River. There are thousands of ephemeral streams with flow after heavy rains and during snowmelt. The outlet is the Colorado

Limnological Data

Surface Data	1981	1990	1993
Trophic Status	M		O
Chlorophyll TSI	-		27.66
Secchi Depth TSI	38.48		44.53
Phosphorous TSI	51.13		41.29
Average TSI	44.80		37.83
Chlorophyll a (ug/L)	-		
Transparency (m)	-		
Total Phosphorous (mg/L)	20		
pH	8.5		
Total Susp. Solids (mg/L)	<5		
Total Volatile Solids (mg/L)	-		
Total Residual Solids (mg/L)	-		
Temperature (°C / °f)	13/55	/	/
Conductivity (umhos.cm)	-		
Water Column Data			
Ammonia (mg/L)	-		
Nitrate/Nitrite (mg/L)	.61		
Hardness (mg/L)	286		
Alkalinity (mg/L)	-		
Silica (mg/L)	-		
Miscellaneous Data			
Limiting Nutrient	-		
DO (Mg/l) at 75% depth	5.6		
Stratification (m)	YES		
Depth at Deepest Site (m)	509		

River. Major upstream reservoirs are the Flaming Gorge Reservoir on the Green River and the Blue Mesa Reservoir on the Gunnison River. The soil associations that compose the watershed are listed in Appendix III.

The watershed receives 15 - 127 cm (6 - 50 inches) of precipitation annually. The frost-free season around the reservoir is 200 - 220 days per year.

Land use in the watershed includes: livestock grazing on private, state, and BLM land (53.7%), forest and woodland (27.2%), multiple use (14.6%), cropland (2.9%), and urban (0.1%).

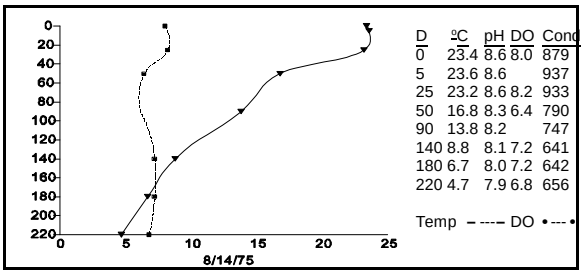
Limnological Assessment

Lake Powell is one of the largest man-made reservoirs in the United States. Due to its vast size and the complexity of the hydrology and limnology associated with the reservoir
only a general characterization of the water will be presented. For further information contact those agencies with oversight jurisdiction over the reservoir. Most of the information here is summarized from the National Eutrophication Survey or from papers produced under the oversight of the Glen Canyon National Recreation Area (GCNRA).

The water quality of Lake Powell is considered very good. It is considered to be moderately hard and saline with a total dissolved solids concentration of approximately 500 mg/L. The only parameters that has exceeded State water quality standards for defined beneficial uses are coliform counts used to assess primary and secondary contact recreation. These exceedences are usually in localized areas receiving heavy recreational use in undeveloped recreational areas. The exceedences occur for only short periods and the GCNRA has a program to monitor and post areas that are in violation. For the period of record (1991--1995 documented incidents occurred in 1991, 1992 and 1995. The lake acts as a sink for nutrients and heavy metals from natural erosion. Currently there are ongoing monitoring efforts by federal and state agencies to document and evaluate the effect of heavy metals in the food chain within the reservoir. Part of these efforts will be to ascertain any potential risks to the public by uptake by fish and their consumption by humans.

The rapid depletion of nutrients available for primary productivity is well documented. With the exception of certain areas near the inflow of tributaries or isolated areas of high recreation use, nutrient concentrations are low. Total phosphorus concentration rage from 8-10 ug/L, well below the state indication for pollution of 25 ug/L. Mean soluble reactive phosphorus values range from 2-3 ug/L (USEPA NES, 1977). All studies substantiate the fact that in general the reservoir is a phosphorus limited system.

The NES reported the reservoir as borderline between oligotrophic and mesotrophic. Data obtained in 1993 indicates that the reservoir is oligotrophic. It is evident that trophic status varies spatially throughout the reservoir, but the generally accepted conclusion is that the reservoir is oligotrophic overall. Profiles obtained on the reservoir indicate that a relatively deep thermocline does develop and that the reservoir is stratified. It appears that dissolved oxygen concentrations may develop sags in late summer or winter but they remain at fairly high levels. Included for reference is a profile taken upstream from the dam on August 14, 1975 as part of the NES.



The Division of Wildlife Resources reports that there are 17 different species of fish in the reservoir. Important game fish present are the rainbow trout (Oncorhynchus mykiss), striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*) bluegill (*Lepomis macrochirus*), walleye (*Stizostedion vitreum*), the channel and black bull head catfish (*Ictalurus punctatus*), and (I. melas), green sunfish (*Lepomis cyanellus*), and the black crappie (*Pomoxis nigromaculatus*). Other species present include the flannelmouth, and humpback suckers (*Catostomus latipinnis*) and redside shiner (*Richardsonius balteatus*), Colorado squawfish (*Ptychocheilus lucius*), speckled dace (Rhinichthys osculus), flathead minnow (*Pimephales promelas*), and threadfin shad (*Dorosoma petenense*). Crayfish are found commonly in Lake Powell.

Lake Powell is also a large and important recreational area administered by the GCNRA. Known to be one of the most appealing vacation spot in the west, Lake Powell furnishes activities from fishing to all kinds of water activities to camping, hiking, and backpacking.

The reservoir has not been chemically treated by the DWR

Phytoplankton in the euphotic zone include the following taxa (in order of dominance) as reported by NES (1977):

Sampling Date	Dominant Genera	Algal Units Per ml

4/16/75	*Chroomonas*	513
	Fragilaria	438
	Cryptomonas	257
	Glenodinium	29
	Other genera	
Total		1,227
8/14/75	*Fragilaria*	816
	Chroomonas	371
	Centric diatom	185
	Navicula	148
	Skeletonema	148
	Other genera	279
Total		1,947
12/01/75	*Chroomonas*	486
	Fragilaria	333
	Cryptomonas	26
	Tetraedron	26
	Scenedesmus	26
	Other genera	
Total		897

Pollution Assessment

Nonpoint pollution sources include: Grazing, recreation, agriculture, urban runoff, silviculture, and hydrological modification. Erosion of soils is one activity with a great impact to the reservoir. The movement of sediments and associated constituents downstream to the reservoir effect water quality and the longevity of the reservoir. An area of concern that impairs water quality at least in a localized manner is recreation. Recreationist contribute to bacterial exceedences in swimming areas due in part to unsanitary practices and the discharge of sewage from mobile housing facilities. In addition an area of concern is the discharge of "gray waters" from watercraft on the reservoir. Gray water is defined as non-sewage wastewaters that can be discharged from a watercraft or other vehicle. These issues are those that receive the most focus and attention in an attempt to control nonpoint sources of pollution.

There are numerous point sources of pollution in the watershed, but most are far enough upstream that they are of no consequence.

Beneficial Use Classification

The state beneficial use classifications include: culinary (1C), recreational bathing (swimming) (2A), boating and similar recreation (excluding swimming) (2B), cold water game fish and organisms in their food chain (3A) and agricultural uses (4).

Information

Management Agencies	
Southeastern Association of Governments	637-5444
Division of Wildlife Resources	538-4700
Division of Water Quality	538-6146
Glen Canyon National Recreation Area	**(602)645-2471**
Recreation	
Canyonlands Travel Region (Monticello)	587-3235
Color Country Travel Region (St. George)	628-4171
Glen Canyon National Recreation Area	(602)645-2471
ARA Leisure Services	1-800-528-6154
Wahweap	(602)645-2433
Bullfrog	(801)684-2233
Halls Crossing	(801)684-2261
Hite	(801)684-2278
Reservoir Administrators	
Bureau of Reclamation	524-5436